

Trading Volume with Private Valuation: Evidence from the Ex-Dividend Day

Roni Michaely
Cornell University

Jean-Luc Vila
Massachusetts Institute of Technology, and Goldman,
Sachs & Co.

We test a theory of the interaction between investors' heterogeneity, risk, transaction costs, and trading volume. We take advantage of the specific nature of trading motives around the distribution of cash dividends, namely the costly trading of tax shields. Consistent with the theory, we show that when trades occur because of differential valuation of cash flows, an increase in risk or transaction costs reduces volume. We also show that the nonsystematic risk plays a significant role in determining the volume of trade. Finally, we demonstrate that trading volume is positively related to the degree of heterogeneity and the incentives of the various groups to engage in trading.

Price and trading volume are the two most important statistics that describe financial market activities.

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Financial economists have developed models to understand how different preferences and information are combined into a single market price. Hence, asset pricing theory can be thought of as a theory of aggregation. In contrast, a theory of market volume must explicitly take agents' heterogeneity into account. While differential liquidity needs or information have been proposed as sources of trading volume, there is no consensus as to their relative importance. Moreover, a theory of volume based on these motives must explain not only the level of volume, but also the timing of the trades.

Constructing a model of trading volume is not a trivial task. Indeed, in complete markets with multiple agents, no trade takes place after the initial trading day [e.g., Arrow (1953)]. Hence, heterogeneous preferences alone cannot explain trading volume. As a consequence, models of volume based on differential preferences have assumed some degree of market incompleteness [e.g., Campbell, Grossman, and Wang (1993), and Dumas (1989)]. Similarly, heterogeneous information alone does not explain market volume, as is shown by the rational expectations literature. If, as is usually assumed, agents have common priors (i.e., they agree on the prior distribution of uncertainty and disagree only after observing different signals), then unobservable liquidity shocks are needed to generate trading [e.g., Grossman (1981), Tirole (1982), and Wang (1993)]. By contrast, if agents have different priors they will trade even in the absence of liquidity shocks [see Biais and Bossaerts (1993), Harris and Raviv (1993), or Kandel and Pearson (1995)]. These models generate important insights about volume behavior and the time-series relationship between price and volume. However, they become intractable in the presence of transaction costs.

In this article, we test a theory of the interaction between investors' heterogeneity, risk, transaction costs, and trading volume. [For a detailed derivation of the model see Michaely, Vila, and Wang (1995).] To test the theory, we take advantage of the specific nature of trading motives around the distribution of cash dividends. Trading around this event results neither from differences in information sets nor from differences in opinions, but from tax-induced differential valuations of dividends.

We analyze trading in the stock market around the ex-dividend day (the first trading date on which the stock trades without the dividend). Because of the differential tax treatment of dividends and capital gains, investors do not value \$1 of dividends as equal to \$1 of capital gains [see Elton and Gruber (1970)]. For example, using the pre-1986 Tax Reform Act rates, individual investors in the highest tax brackets were subject to a 50 percent tax rate on dividend income and a 20 percent tax rate on capital gains (provided the stock was held for at least

6 months). Such an investor valued \$1 of dividend income at \$.625 of capital gains income.¹ By contrast, corporate investors who had a higher tax rate on capital gains income (46 percent) than on dividend income (6.9 percent) valued dividend income more than capital gains income: With these rates, corporations saw no difference between \$1 of dividend income and \$1.72 of capital gain income.² Finally, tax-exempt investors valued \$1 of dividend income at \$1 of capital gains income.

Since the tax code creates differences in asset *valuation* as opposed to differences in opinion or information, tax-related trading will occur around the ex-day in a fairly predictable manner. For now, consider the following stylized example: (i) \$1 in dividends is paid, (ii) the cum-day (the last date that the stock trades with the dividend) price is \$100, and (iii) the price drop subsequent to the payment of the dividend is known and equal to \$.80. In this case, investors who value the dividend for more than \$.80 will buy the stock, cash the dividend, and sell it later at an \$.80 loss. By contrast, an investor who values the dividend for less than \$.80 follows the opposite trading strategy. With the tax rates described in the previous paragraph (and ignoring transaction costs and risk for the time being), the after-tax per-share profits of the individual, tax-exempt, and corporate investors are \$.14, \$.20, and \$.50 per transaction, respectively.

From our discussion above, it is clear that a greater degree of tax heterogeneity in the economy leads to a higher volume around the ex-day. By contrast, risk and transaction costs reduce volume by making more costly the transfer of dividend-paying stocks from investors who do not like dividends to those who do.

First, a tax “arbitrage” strategy entails a (temporary) deviation from optimal risk sharing, since around the ex-day, investors do not hold the market portfolio.³ For example, a corporate investor buying for

¹ $(1 - .5)/(1 - .2) = .625$.

² Prior to the 1986 Tax Reform Act (TRA), individual investors who held a stock for at least 6 months paid a lower tax on capital gains (20 percent) than on ordinary dividends (50 percent). The TRA eliminated most of the distinctions between capital gains and ordinary income. However, it is still possible to defer taxes on capital gains by not realizing the gains. Before the 1986 TRA, a corporation that held the stock of another corporation paid taxes on only 15 percent of the dividend. Therefore, the effective tax rate for dividend income was $.15 \times .46 = .069$. After the TRA, the corporate income tax rate was reduced to 34 percent. The fraction of the dividend exempted from taxes was also reduced to 70 percent. The effective tax rate for dividend income was therefore increased to $.3 \times .34 = .102$. In both time periods the dividend exemption could be as high as 100 percent if the dividend-paying corporation was a wholly owned subsidiary of the dividend-receiving corporation.

³ In this article, we refer to a tax-induced trading strategy as a tax “arbitrage.” Academics usually define an arbitrage strategy as a trading strategy that costs nothing and yet risklessly provides positive cash flows. However, a more recent literature recognizes that in the presence of frictions, arbitrage strategies are often risky investment strategies [see Tuckman and Vila (1992, 1993)].

tax purposes a stock going ex will be overexposed to movements of the stock's price. This risk will be large if the minimum holding period necessary to claim the dividend exclusion is large. But even if the stock is only held overnight, the risk is not trivial. Assuming an overnight risk of about \$1 on a \$100 stock, which is not unreasonable, one can see that tax-related trading should be treated not as a pure arbitrage, but as a risky investment.

Second, transaction costs must be taken into consideration, given that the potential gains are only a fraction of the dividend and are therefore relatively small compared to the stock price. Indeed, the typical (retail) brokerage costs for common stocks averages 2 percent on the dollar amount of the trade, while the bid-ask spread for actively traded stocks average around .5 percent [see Aiyagari and Gertler (1991)]. This implies that dividend capture is probably not profitable for small investors who face large transaction costs, and that only liquid stocks with a high dividend yield will show a significant amount of tax-related trading around the ex-day.

Finally, the theory indicates that risk and transaction costs interact in a very interesting way. If transaction costs are negligible, only idiosyncratic risk restricts volume: Market risk can be hedged costlessly and does not affect volume. As transaction costs increase, it becomes more and more costly to hedge the market risk. Consequently, the importance of the market risk in restricting trading volume increases as transaction costs increase.⁴ In the intermediate case, both the market risk and the idiosyncratic risk will affect volume, but the effect of the latter will be smaller.

Thus the main hypotheses of this article are that (i) investors heterogeneity in valuation creates volume, (ii) transaction costs reduce volume, and (iii) risk reduces volume. At this stage, only hypothesis (iii) deserves comment. To our knowledge, the existing empirical evidence shows that on regular trading days, volume and volatility are *positively* correlated [see, for instance, Gallant, Rossi, and Tauchen (1992)]. There is no theoretical contradiction; on regular trading days, investors may trade for risk-sharing purposes, but because of transaction costs they do not achieve a Pareto optimal risk sharing [e.g., Heaton and Lucas (1995)]. When risk increases, the cost of deviating from the Pareto optimal holdings also increases, and therefore volume increases. By contrast, on the ex-day, investors trade *away* from their optimal holdings and hence risk reduces volume.

⁴ These results apply to changes in transaction costs that are associated with the ability to hedge the systematic risk. For example, the cost of hedging by buying or selling the market portfolio or a stock index future.

In our empirical analysis, we consider the *abnormal volume* around the ex-day, that is, the volume in excess of regular volume. We find that the abnormal volume is significant, and varies over time and across stocks. In particular, the abnormal volume is much larger for high-yield stocks. This is consistent with the model's prediction, since tax-induced trading in high-yield stocks is more profitable than in low-yield stocks for the same level of risk and transaction costs. It is also consistent with previous evidence by Grundy (1985) and Lakonishok and Vermaelen (1986).

Next, we document that both the market risk and the idiosyncratic risk negatively affect the level of volume, but that the impact of the market risk is lower. We then turn to the direct relationship between transaction costs and trading volume. Using the bid-ask spread as a measure of transaction costs, and dividing stocks into three groups according to their bid-ask spread, we find that abnormal volume is about five times higher for low-transaction-cost stocks than for high-transaction-cost stocks. This simple unconditional result extends to a multivariate cross-sectional regression analysis. We use the abnormal volume as the left-hand-side variable, and dividend yield, beta, idiosyncratic risk, market value of equity, and bid-ask spread as right-hand-side variables. The latter is found to have a significant negative coefficient.⁵ Consistent with the model's implications, we are also able to demonstrate that the effect of the market risk increases, and the effect of idiosyncratic risk decreases, with transaction costs.

To interpret these results, remember that we are talking about *abnormal volume*. While the negative relationship between transaction costs and volume has been documented elsewhere [see, for instance, Demsetz (1968) and Stoll (1989)], our results indicate that transaction costs inhibit trading proportionally more when agents engage in arbitrage transactions than transactions on normal trading days.

So far we have seen that tax arbitrage strategies subject investors to both risk and transaction costs. Derivative securities, such as options and futures, allow investors to hedge, that is, reduce risk, at a relatively small cost. We provide both time-series and cross-sectional evidence that the presence of options increases abnormal volume. We find that after an option on a particular stock is listed, the abnormal ex-day volume on this particular stock goes up. We also find that stocks with listed options exhibit more abnormal volume than similar

⁵ This negative relationship between transaction costs and abnormal volume can also be detected from time-series evidence. In May 1975, brokerage commission schedules were changed from fixed to negotiated, thereby substantially reducing the cost of transacting, especially for large traders. Consistent with Lakonishok and Vermaelen (1986), we find that abnormal volume around the ex-day goes up after that date.

stocks without listed options. Consistent with the role of options as hedging vehicles in the ex-day trading, we also find that when options are available, the ex-day trading volume is less sensitive to the idiosyncratic and systematic risk of the underlying stock.

Finally, we provide time-series evidence that a greater degree of heterogeneity generates higher abnormal volume. Our results indicate that heterogeneity has a significant effect on trading volume, especially in stocks where corporate and institutional traders are more dominant.

This article is organized as follows. Section 1 presents the model's intuition and its empirical implications. Section 2 presents the data set. The empirical results are detailed in Section 3, and Section 4 contains concluding remarks.

1. Empirical Implications

Our empirical investigation is based on a dynamic equilibrium model with heterogeneous investors, detailed in Michaely, Vila, and Wang (1995). In the particular case considered here, investors have heterogeneous valuations of assets because they face different taxes on dividend and capital gains. All assets in this economy can be traded on three dates, the cum-day, that is, the last day where stocks are still traded with the dividends; the ex-day, that is, the first day they are traded without the dividends; and a final liquidation day. Each time an investor trades in any of the assets (some of which pay dividends) he is subject to proportional transaction costs. In equilibrium, and under the assumptions of normality and a CARA utility function, the model yields the following empirical implications:

Implication 1. *The trading volume is an increasing function of the degree of tax heterogeneity in the economy.*

The trading motives in this economy are based on differential valuation. As the differences in valuation widen, that is, as the tax heterogeneity increases, the gains from trade increase. Hence, trading volume goes up.

Implication 2. *The trading volume is an increasing function of the dividend yield.*

The intuition here is quite clear. As the dividend yield increases, the gains from transferring the dividend from investors who are averse to it (e.g., individual investors in high tax brackets) to investors who are

less averse (investors in low tax brackets), or to investors who prefer dividends (such as corporate investors), also increase.⁶

Implication 3. *Trading volume is lowered by the presence of transaction costs.*

Transaction costs limit both the number of investors and the trading activity of those who participate in the ex-day trading. Not only do investors trade less in the dividend-paying stock, they also hedge their trades to a lesser extent. Thus transaction costs make tax arbitrage not only more costly, but also more risky. The effect on volume is clear: it is reduced.

Implication 4. *Trading volume is a decreasing function of the idiosyncratic risk σ^2 .*

As in many of the asset pricing models, the stock's risk can be decomposed into two parts: systematic and idiosyncratic. Unlike prices, the idiosyncratic risk affects volume. The reason is simple: investors buying (selling) dividend-paying stocks find themselves over-underinvested in these stocks. As a result, they are exposed to the idiosyncratic risk of these stocks. In equilibrium, the over-underexposure does not affect pricing, but it does affect each investor's decision on how much to trade. Consequently, idiosyncratic risk inhibits trading volume.

Implication 5. *In the absence of transaction costs, trading volume is independent of the market risk component of the stock risk. When transactions are costly, trading volume is a decreasing function of both the market risk component of the stock risk and its idiosyncratic component. The effect of the idiosyncratic risk is stronger.*

In the absence of transaction costs, the market risk component can be hedged costlessly and so does not inhibit trading. In the presence of transaction costs, trading strategies are naturally more complicated. First, investors who perceive the cost of trading as too large relative to the benefit will not engage in trading. Other investors may trade, but will not find it worthwhile to hedge.⁷ Investors whose private valuation is quite different from the market's will hedge, at least partially.

⁶ Assuming that all other factors such as risk and transaction costs remain constant.

⁷ Note that there are several mechanisms to hedge systematic risk, given the currently available financial instruments. For example, hedging the market risk can be done either in the spot or in the futures market. An investor will usually choose the cheapest instrument available. Before the introduction of the first futures contract, the relevant transaction costs were those in the spot market. Since the trading costs in the futures market are lower than in the spot market, an introduction of a new futures contract reduces, in effect, the cost of hedging.

Thus, with transaction costs, investors are exposed to the additional market risk, which will affect their trading decision. Similar to the no transaction costs case, all trades are affected by the idiosyncratic risk. Only some of the trades are affected by the systematic risk, because part of the trades are hedged. Consequently, idiosyncratic risk will have a stronger effect on volume.

Implication 6. *As transaction costs increase, the trading volume is less sensitive to the idiosyncratic risk.*

In the presence of transaction costs, investors take smaller and smaller positions. This is particularly true for investors who do not hedge. As a result, the idiosyncratic risk is less of a factor in the determination of the trading volume.

To summarize, Implications 4, 5, and 6 concern the interplay between risk and transaction costs, and their effect on trading volume. The model implies that systematic risk will have no effect on trading volume if there are no transaction costs, but will have a negative impact if there are transaction costs. On the other hand, idiosyncratic risk will have a negative effect on trading volume with or without transaction costs. In addition, the interaction between those risk factors and transaction costs results in an opposite prediction about their effect on trading volume: the higher the level of transaction costs, the lower the impact of the idiosyncratic risk on trading volume, and the higher the impact of the systematic risk. The intuition behind the result that idiosyncratic risk has a lesser role when transaction costs are high is that agents will tend to hedge less, and consequently assume significantly smaller positions.

Implication 7. *Trading volume of each individual stock is a decreasing function of the number of stocks going ex.*

This may seem counterintuitive since, when many stocks are going ex, the dividend-paying portfolio contains less idiosyncratic risk and there will be more *aggregate* dividend arbitrage trading. But the trading volume per stock will be lower, since agents' willingness to assume a nonoptimal amount of market risk is limited. An analogous situation occurs in portfolio theory: a constant absolute risk aversion investor having access to two positively correlated assets will invest less in each of them than he would if he had access to only one of them. However, the total amount invested will be higher. Because not all the systematic risk is hedged, those investments are indeed correlated. If there are no transaction costs, all systematic risk is hedged, those investments are uncorrelated, and consequently the trading vol-

ume on any stock going ex does not depend on the number of stocks going ex.⁸

2. Data

Data on dividend distributions, ex-dividend dates, and daily trading volume are compiled from the 1991 CRSP daily master tapes. Stocks are included in the sample if they are listed on the NYSE or AMEX between January 1963 and December 1991, and pay a taxable cash dividend (distribution types 1212 through 1292 on the CRSP tapes). Ex-dividend day events are included in the sample if

1. There are at least 40 daily volume observations in the estimation period (days -45 to -6 , and days $+6$ to $+45$) that can be used to estimate the expected daily trading volume.
2. There are at least 40 daily return observations in the estimation period to estimate the systematic and idiosyncratic risk components.
3. The trading volume is positive in at least one of the 11 days around the ex-day.

The final sample consists of 155,302 taxable cash dividend distributions. Dividend yields are calculated as the dividend amount over the cum-dividend day price. We use the average of market value of equity in the 80-day estimation period as a proxy for the firm's market capitalization around the event. Our investigation also requires estimates of bid-ask spreads. We use data from the 1988 to 1990 ISSM transaction files to calculate the average bid-ask spread.

To examine the effect of hedging on trading around the ex-day, we collect a comprehensive sample of all stocks with a traded option. Our initial sample consists of all options listed on the CBOE, NYSE, AMEX, Pacific Stock Exchange, and Philadelphia Stock Exchange from 1973 through 1987, with an underlying asset that is traded on the NYSE or AMEX. A firm is included in the sample if return data were available for 10 years centered around the option inception, at least four ex-dividend dates occurred in the 3 years prior to the option listing, and at least four ex-dividend dates occurred in the 3 years after the option listing. This sample contains 448 stocks.

3. Empirical Results

3.1 Summary statistics and variable definitions

Table 1 contains summary statistics on the abnormal volume (AV), the cumulative abnormal volume (CAV) for the 11 days centered around

⁸ If transaction costs are proportional, investors are better off investing in all stocks going ex rather than just a subset. If transaction costs have a fixed component, investors would prefer to trade only in a subset of the dividend-paying stocks.

Table 1
Descriptive statistics of ex-dividend day abnormal volume and bid-ask spread

	Entire sample	Dividend yield group			
		High	Medium	Low	
(1) AV(0)	14.69% (24.62)	32.82% (23.92)	6.18% (8.22)	5.07% (5.86)	
(2) CAV(-5 → +5)	100.6% (33.07)	196.3% (25.47)	53.63% (15.27)	51.85% (15.50)	
(3) WCAV (-5 → +5)	179.7% (21.93)	449.2% (18.99)	62.87% (8.59)	26.96% (4.51)	
(4) Mean dividend yield (%)	1.001	1.70	0.89	0.41	
(5) Number of observations	155302	51767	51767	51768	
(6) Average daily turnover	0.0016	0.0012	0.0015	0.0021	

Bid-ask spread statistics (%)											
Size group ¹	ALL	1	2	3	4	5	6	7	8	9	10
		(small)									(large)
Mean	1.54	2.88	2.21	1.89	1.70	1.50	1.41	1.26	1.06	0.85	0.68
Median	1.31	2.50	1.96	1.75	1.55	1.37	1.27	1.14	0.96	0.81	0.63
S.D.	0.99	1.58	0.97	0.71	0.66	0.65	0.69	0.54	0.42	0.29	0.27

Descriptive statistics on ex-dividend day abnormal volume, AV; cumulative abnormal volume for the 11 days centered around the ex-dividend day, CAV; the dividend yield and the bid-ask spread for a sample of ex-dividend events on NYSE/AMEX stocks in the years 1963 to 1991. Statistics are provided for the entire sample and separately for each of the three dividend-yield groups. Abnormal volume is calculated as the daily turnover relative to normal turnover (in the 90 days around the event), and the dividend yield is defined as the dividend amount over the cum-day price. The bid-ask spread for each stock is calculated as:

$$BAS_i = \frac{1}{T_i} \sum_{t=-5}^{+5} \frac{1}{3} \sum_{j=1}^3 \left\{ (Ask_{tji} - Bid_{tji}) / \left[\frac{Ask_{tji} + Bid_{tji}}{2} \right] \right\}$$

where j = open, midday, and close transaction; t is the day relative to the ex-dividend day; and T_i is the number of days in the event period with valid bid-ask observations (usually 11 days). t -statistics are in parentheses.

¹There are 15,893 observations in the 1988 to 1990 sample. All groups (except the smallest) contain 1,590 observations.

the ex-dividend day, and the cumulative abnormal volume weighted by the market capitalization of the firms going ex (WCAV). To compute these variables, we first calculated the mean volume in the estimation period for each event. The mean volume for event i is defined as the mean daily turnover for days -45 to -6 and $+6$ to $+45$:

$$ATO_i = \frac{\sum_{t \in [-45, -6] \cup [+6, +45]} TO_{it}}{T} \quad (1)$$

where TO_{it} is the daily turnover (shares traded relative to shares outstanding) for security i on day t , and T is the number of days with valid volume observations in the estimation period.

Then, for each day in the event period we calculated the abnormal

volume as

$$AV_{it} = \frac{TO_{it}}{ATO_i} - 1 \quad t \in -5, \dots, +5 \quad (2)$$

The mean daily abnormal turnover for the entire sample is calculated as

$$AV_t = \frac{\sum_{i=1}^N AV_{it}}{N} \quad t \in -5, \dots, +5 \quad (3)$$

where N is the number of events with valid observations on day t .

Alternatively, one may argue that more weight should be given to larger stocks, since a higher turnover in those stocks implies much higher abnormal dollar volume than the same turnover for smaller stocks. Hence, we also compute the average daily turnover, weighted by the stock's market capitalization:

$$WAV_t = \frac{\sum_{i=1}^N AV_{it} \cdot \bar{C}_i}{\sum_{i=1}^N \bar{C}_i} \quad t \in -5, \dots, +5 \quad (4)$$

where $\bar{C}_i$ is the stock's market capitalization calculated as

$$\frac{\sum_{t \in [-45, -6] \cup [+6, +45]} P_{it} \cdot S_{it}}{T} \quad (5)$$

and P_{it} and S_{it} are the stock price and number of shares outstanding for event i in day t , respectively.

The cumulative abnormal volume is the sum of the daily abnormal volume for the 11 days around the event, that is,

$$CAV_i = \sum_{t=-5}^{+5} AV_{it} \quad (6)$$

The average cumulative abnormal volume (CAV), and the weighted average cumulative abnormal volume (WCAV), are defined in the same way as AV and WAV for abnormal volume. T -statistics for the volume behavior around the ex-dividend day are calculated using the cross-sectional estimates of the variance of abnormal volume.⁹

For the entire sample, the ex-dividend day volume is 14.69 percent higher than average, and in the 11-day period, the cumulative abnormal volume is more than 100 percent higher than regular trading volume. Both are significant with t -statistics of 24.62 and 33.07, respectively. The average dividend yield in the sample is 1.001 percent.

⁹ Korajczyk, Lucas, and McDonald (1991) use this procedure to examine price behavior around seasoned equity issue announcements.

In the table, we also report the volume statistics when the sample is partitioned by dividend yield. Observations are sorted into three groups according to their yield, and means are calculated within each yield group. The mean dividend yields for the high-, medium-, and low-yield groups are 1.70, 0.89, and 0.41 percent, respectively. Both the ex-day abnormal volume and the cumulative abnormal volume increase monotonically with yield. A significant difference, however, is observed only between the medium- and high-yield groups: 6.18 versus 32.82 percent abnormal volume. In fact, for the high-yield group, the CAV is almost 200 percent, and is more than three times higher than for the medium-yield group. The size-weighted cumulative abnormal trading volume is higher than the unweighted CAV. For example, for the high-yield group, WCAV is 449 percent, more than double the CAV (196.3 percent). As we will discuss later, the higher size-weighted volume may be related to the negative association between size and transaction costs.¹⁰

The finding of positive association between dividend yield and abnormal volume is consistent with Implication 2 as well as with several prior findings. Using a sample of 1,200 ex-dividend days, Grundy (1985) finds that the trading volume for the group with a dividend yield greater than 1.2 percent is higher than for the group with a dividend yield less than 1.2 percent. Similarly, Lakonishok and Vermaelen (1986) report an increase in abnormal trading in the 3 days preceding the ex-day of high-yield stocks.

From Table 1 we can see that trading due to the upcoming dividend does not occur only on the cum- and ex-days, but starts several days before the ex-day, and ends several days after. Therefore, in subsequent analyses we report the results using the cumulative abnormal trading volume in the 11 days around the ex-day.

The second part of Table 1 contains information about the bid-ask spreads of the stocks in our sample. The bid-ask spread is used as one of our proxies for cross-sectional differences in transaction

¹⁰ We repeated the entire experiment for ordinary quarterly dividends only. The results are virtually the same as those reported in the body of this article. This is not surprising, given that over 91 percent of the dividends in our sample are quarterly dividends. (2.30 percent are monthly, 2.38 percent are categorized as unspecified, 1.2 percent are semiannual, and 1.68 percent are special. No other category has more than 0.3 percent of the observations.) Also, the inclusion of events with zero trading volume on the ex-day does not affect any of our conclusions. Finally, to ensure that our results are not due to "spillover" of abnormal volume from the announcement date, we included only events in which the announcement date was at least 4 days prior to the ex-dividend day. The sample contains 138,142 ex-day observations (about 89 percent of the original sample). The cumulative abnormal volume for this sample is 94.7 percent ($t = 23.46$) compared with a CAV of 100.6 percent for the entire sample. The ex-dividend day abnormal volume is 14.0 percent ($t = 16.71$) compared with an AV of 14.7 percent for the entire sample. We repeated several of the experiments described below with this subsample. None of our conclusions changed.

costs. There are several reasons why it is considered to be a good proxy. First, for many of the traders involved in ex-day trading (such as corporations and institutional investors), the bid-ask spread is the major component of their transaction costs. Second, as Stoll and Whaley (1983) show, the correlation between total transaction costs and the bid-ask spread is very high. Finally, using a sample of NASDAQ firms, Karpoff and Walkling (1990) show that the ex-day excess return is positively correlated with the bid-ask spread, consistent with the effect of transaction costs on ex-day returns in the presence of arbitrageurs.

The ISSM data includes intraday bid-ask spreads, which were used to estimate the average bid-ask spread for each event in our 1988 to 1990 sample. For each day in the event period, we use the opening, midday, and closing bid-ask spread to calculate a daily spread. The mean spread for event i is defined as the average daily spread over the event period:

$$BAS_i = \frac{1}{T} \sum_{t=-5}^{+5} \frac{1}{3} \sum_{j=1}^3 \frac{Ask_{tji} - Bid_{tji}}{\frac{1}{2}(Ask_{tji} + Bid_{tji})} \quad (7)$$

where j = open, midday, or close transaction, t is the day relative to the ex-dividend day, and T_i is the number of days in the event period with valid observations.¹¹

Table 1 contains some statistics on the bid-ask spread, using a sample of 15,893 ex-dividend day events in the period 1988 to 1990. (Because of data limitations on the bid-ask spread, our sample contains events from 1988 to 1990 only.) The mean and median spread are 1.54 and 1.31 percent, respectively, and the standard deviation of the mean spread is 0.99 percent. We also measured separately the bid-ask spread for the 10 firm-size groups. The spread decreases monotonically with size (both the mean and the median). For example, the mean spread for the smallest size group is 2.88 percent, and only 0.68 percent for the largest size group. It should be noted, however, that for some traders the actual bid-ask spread may be lower than that reported in Table 1. First, recent evidence [Lee (1993)] shows that about 62 percent of the trades on the NYSE are executed between the bid and ask quotes. Hence, the quoted bid-ask spread overstates the actual spread. Second, since the ex-day trades are primarily noninformational, it is possible that on the cum- or ex-days themselves, the actual spread will be lower. Indeed, Koski (1991) shows that the average relative bid-ask

¹¹ We repeated all our experiments when the bid-ask spread is calculated during the estimation period. None of our results changed.

spread on the cum-day alone is around 0.65 percent, compared with a regular day bid-ask spread of 1.53 percent in our sample.¹² In addition, Koski (1992) brings direct evidence from the ex-day activity to show that some large traders are able to substantially reduce the actual bid-ask spread through bilateral bargaining. However, as long as the cross-sectional differences in the observed bid-ask spreads reflect the actual cross-sectional differences in transaction costs, our conclusions are not altered.

3.2 Risk, transaction costs, and trading volume around the ex-dividend day

3.2.1 Transaction costs. As the cost of trading increases, fewer investors find it profitable to trade around the ex-day, and those who do will trade for lesser amounts (Implication 3). The cross-sectional implication here is that stocks with lower transaction costs will exhibit higher abnormal trading volume around the ex-dividend day. To this end, we first divide the sample into three subgroups according to the cost of trading, estimated by the security's bid-ask spread [see Equation (7)]. Indeed, as reported in the last row of Table 2, as transaction costs increase, the abnormal volume decreases. For the low-transaction-costs group, the cumulative trading volume is 556.10 percent higher than the average trading volume, and is only 78.47 percent higher for the group with the highest transaction costs. For all groups, however, the CAV is significantly greater than zero.

However, as we have established in Implication 2 and Table 1, the incentive to trade increases with dividend yield as well. In order to distinguish between the yield effect and the cost-of-trading effect, we divided the sample into nine categories. Each event is categorized by its dividend yield and average bid-ask spread. The mean dividend yields for the three categories are 0.387, 0.805, and 2.08 percent for the low-, medium-, and high-dividend yield groups, respectively. Each dividend yield group contains approximately 5,300 observations. We subdivide each of the three subsamples by the cost of transacting, estimated by the bid-ask spread around the ex-day, and measure the abnormal volume for each of the nine subgroups. Our model predicts that the volume of trade should increase within each yield group as transaction costs decrease. Moreover, if there is more arbitrage and dividend capture in the high-yield stocks, then the increase in the

¹² Supporting evidence for this claim can also be found in Castanias, Chung, and Johnson (1988) and Madhavan and Smidt (1991). Madhavan and Smidt find that the informativeness of the trade significantly affects specialist behavior. Castanias, Chung, and Johnson report that the bid-ask spread for informationless trades in options is much smaller than for normal trades.

Table 2
Transaction costs and ex-day trading volume: cross section analysis

	← BAS category →			
	Low (1.47%)	Medium (1.49%)	High (1.64%)	All (1.53%)
↑ Dividend yield category ↓				
Low (0.387%)	57.03 (2.90) [1852]	52.42 (2.61) [1777]	31.67 (1.75) [1666]	47.5 (4.25) [5295]
Medium (0.804%)	75.58 (4.77) [1808]	43.42 (2.65) [1803]	20.45 (0.97) [1687]	47.2 (4.60) [5298]
High (2.078%)	1649.5 (9.60) [1640]	1236.1 (11.84) [1720]	169.1 (5.88) [1940]	973.4 (15.10) [5300]
All	556.1 (10.15) [5300]	433.5 (12.11) [5300]	78.47 (5.71) [5293]	

Ex-dividend events are divided into nine categories by dividend yield and bid-ask spread. The sample is first sorted by yield into three groups and then by bid-ask spread, resulting in nine subgroups. The bid-ask spread is calculated as the average bid-ask spread in the 11 days around the ex-day [see Equation (7)]. Dividend yield is calculated as dividend amount over the cum-dividend day price. The average cumulative abnormal volume (in percent) is then calculated for each category. *T*-statistics appear in parentheses and number of observations appear in brackets. The ex-dividend day events are constraint to the years 1988 to 1990.

abnormal volume should be more pronounced in those stocks than in the lower-yield stocks.

The results indicate that the group with the highest yield and the lowest cost of transactions experiences the highest volume of trade around the ex-day, more than 17 times the normal trading volume. For the high-yield group (Table 2, row 3), an increase in transaction cost has the biggest (negative) effect on abnormal volume. The trading volume for the high-yield/high-transaction-cost group is only 2.7 times the regular trading volume. Consistent with the concentration of short-term and corporate traders in high-yield stocks, we see that the trading volumes in low- and medium-yield stocks are not affected by increases in transaction costs to the same extent as the trading volume in high-yield stocks.¹³

¹³ In order to use a longer period in our analysis, we construct an additional measure of transaction costs, namely the market capitalization of firms that are going ex. The use of market capitalization as a proxy for the cost of transacting is largely motivated by the empirical finding of negative correlation between the bid-ask spread and market capitalization. For the events in the period 1988 through 1990 we find that the correlation coefficient is -0.298 (see also Table 1). [We are not

The length of our sample period enables us to observe a profound structural change in transaction costs and to test its effect on the incentives to trade around the ex-day. The May 1975 change in commission schedules (from fixed to negotiated) substantially reduced the cost of transacting, especially for large traders. Therefore, one would expect an increase in the abnormal volume of trade after 1975. We find that there is a marked increase in the abnormal trading volume around the ex-dividend day in the period 1976 to 1991, compared to the first period of 1963 to 1975. For the entire sample, the CAV is 150 percent for the 1976 to 1991 period and 29.4 percent for the 1963 to 1975 period. The increase is more pronounced for the high-yield stocks (than for the medium- or low-yield stocks) with a CAV of 26 and 311 percent for the first and second periods, respectively.¹⁴ These results are also consistent with what has been reported by Lakonishok and Vermaelen (1986).

3.2.2 Risk. Implications 4 and 5 state that both the idiosyncratic risk and the systematic risk have a nonpositive effect on the level of abnormal trading volume. In the presence of transaction costs, Implication 5 states that both risk factors have a negative effect on trading volume, and that the effect of the idiosyncratic risk is stronger. We examine the effects of these two types of risk using a regression analysis and report them in Table 3. The dependent variable is the cumulative abnormal volume in the 11 days around the ex-day. The independent variables are the stock's dividend yield, the idiosyncratic risk normalized by the market risk at the same time period, and the systematic risk, beta. The latter two variables are calculated during the

the first to use market capitalization as a proxy for transaction costs in this context. Karpoff and Walkling (1988) and Lakonishok and Vermaelen (1986) use a similar measure.] The results show a similar pattern to that described in Table 2: the abnormal volume of trade increases as the cost of transacting is reduced, and this increase is more pronounced for the high-yield group than for the low-yield group. As with the case of the bid-ask spread, the group that is associated with the lowest transaction costs and highest dividend yield exhibits the largest abnormal trading volume, almost five times more trading than on regular days. Also, for the largest firms (i.e., lowest cost of trading), abnormal volume increases monotonically with yield. For the medium- and small-size groups, however, there is not much difference between the trading volume for the medium- and low-yield stocks.

¹⁴ We also calculate the level of abnormal trading volume for a shorter time period around the change in the commission schedules in 1975. For the entire sample, the CAV is 42.4 and 66.43 percent for the periods 1971 to 1975 and 1976 to 1980, respectively. This difference is both economically and statistically significant. However, it is smaller than what is reported in the body of this article, when the entire 1963 to 1991 period is being used. There are several potential reasons that may account for it. First, transaction costs continue to go down even after 1975. (Transaction costs encompass more than just commissions. For example, the costs of tracking and monitoring various positions have gone down as the use of faster computers has become more common.) Second, as we discuss in detail in the next section, many hedging instruments became available during the 1980s; for example, futures contracts on several indices and options on individual securities, all of which made the ex-day trading more attractive.

Table 3
The effect of transaction costs and risk on ex-day trading

$$CAV_i = \alpha_0 + \alpha_1 \left(\frac{D}{P} \right)_i + \alpha_2 \frac{\sigma_{ei}}{\sigma_m} + \alpha_3 \beta_i + \alpha_4 BAS_i + \alpha_5 Size_i$$

Panel A: 1963–1991

Dep. Var. (CAV)	Intercept	$(D/P)_i$	σ_{ei}/σ_m	β_i	$Size_i$	$\bar{R}^2$
(1) Entire sample	1.89 (15.89)	63.17 (8.51)	−0.49 (−18.19)	−0.37 (−9.34)	0.134 (5.72)	1.56
(2) High yield	4.28 (14.36)	52.23 (6.27)	−1.18 (−14.28)	−0.91 (−8.02)	0.21 (9.09)	3.20
(3) Medium yield	1.476 (5.81)	−12.65 (−0.48)	−0.22 (−7.99)	−0.16 (−3.88)	−0.007 (−1.19)	0.68
(4) Low yield	0.943 (7.567)	41.649 (2.51)	−0.117 (−4.29)	−0.23 (−4.39)	−0.04 (−5.01)	0.75

Panel B: 1988–1990

Dep. Var. (CAV)	Intercept	$(D/P)_i$	σ_{ei}/σ_m	β_i	BAS_i	$Size_i$	$\bar{R}^2$
(1) Entire sample	8.49 (9.6)	84.48 (5.32)	−2.07 (−2.96)	−0.95 (−2.98)	−70.5 (−3.03)	−0.015 (−0.704)	2.61
(2) High yield	18.49 (10.97)	30.43 (3.79)	−2.76 (−4.56)	−0.346 (−0.81)	−222.95 (−3.04)	−0.122 (−0.77)	2.98
(3) Medium yield	0.74 (0.95)	36.06 (0.412)	−0.506 (−3.676)	−0.17 (−0.95)	12.3 (0.916)	−0.015 (−0.588)	0.74
(4) Low yield	1.96 (4.21)	−71.92 (−0.74)	−0.47 (−3.70)	−0.12 (−0.56)	−5.24 (−0.393)	−0.049 (−1.43)	0.83

The effect of transaction costs and risk on ex-day trading is analyzed using a regression analysis. The dependent variable is the CAV in the 11 days around the ex-dividend day for the entire sample (first row), for the high-yield group (second row), for the medium-yield group (third row), and for the low-yield group (fourth row). The independent variables are the stock's dividend yield, calculated as the dividend paid over the cum-day price, the idiosyncratic variance, scaled by the market variance in the same time period, and the systematic risk, estimated by beta. The latter two variables are estimated using the OLS market model during the estimation period. In panel A, we use size (average market value of equity in the estimation period) as our proxy for the cross-sectional variation in transaction costs. In panel B, we also use the average bid-ask spread (BAS) in the 11 days around the event [see Equation (7)] as an additional transaction costs proxy. Standard errors are adjusted for heteroskedasticity using White's (1980) procedure. *T*-statistics are reported in parentheses.

estimation period from daily return observations. In addition, we have included our two proxies for transaction costs: the firm's market value of equity, $SIZE_i$ [see Equation (5)], and the average bid-ask spread, BAS_i [see Equation (7)].

Consistent with the model's implications, both the idiosyncratic risk coefficient and the beta coefficient are negative, with values of −0.49 and −0.37, respectively (Table 3, first row in panel A). Both coefficients are significantly different from zero, with *t*-statistics of 18.19 and 9.34, respectively. The idiosyncratic risk coefficient is about 35 percent

higher (in absolute value) than the beta risk coefficient. The difference is significant, with a t -statistic of 3.03. These findings give a preliminary indication that investors do hedge their transactions, but do so only partially due to transaction costs: if investors do hedge all of the systematic risk, then the beta coefficient is zero. (Since the systematic risk is fully hedged, it should not affect trading volume. See Implication 5.) If investors do not hedge any of the systematic risk involved in the ex-day transaction, then both the beta coefficient and the idiosyncratic risk coefficients should have the same effect on trading volume. Thus, a significant beta coefficient that is smaller than the idiosyncratic risk coefficient is consistent with the assertion that the systematic risk is being hedged, but only partially, presumably because of transaction costs.

Consistent with the discrete categorization analysis, the dividend yield coefficient is positive and highly significant (with a t -statistic of 8.51), and the size coefficient is positive and significant (t -statistic of 5.72). These effects are both statistically and economically significant. For example, the yield coefficient indicates that an increase of 1 percent in dividend yield will result in an increase in abnormal volume of 63 percent. Likewise, a beta increase from, say, 1 to 1.5 will cause an 18 percent reduction in abnormal volume.

In the last three rows of the panel we repeat the analysis for each of the three dividend yield groups separately. The results for the high-yield group are similar to those of the entire sample, though the sensitivity of the abnormal volume to changes in the risk components and the cost of transacting is more than double that for the entire sample. The idiosyncratic and beta risk coefficients are negative and significant for the medium- and low-yield groups. The dividend yield coefficient is positive and significant for the low-yield group and insignificant for the medium-yield group.

In panel B of Table 3 we also include the bid-ask spread as a transaction costs proxy. The sample period is therefore limited to the 1988 to 1990 time period. The pattern that emerges is similar to that in panel A: the spread coefficient is negative and highly significant for the entire sample as well as for the high-yield group, with t -statistics of -3.03 and -3.04 , respectively. The spread coefficient is statistically insignificant for the medium- and low-yield groups. The idiosyncratic risk coefficient is negative and significant for the entire sample and each subgroup. The beta coefficient has the right sign, and is significant for the entire sample. The fact that the size coefficient is insignificant when the bid-ask spread is included reinforces our assertion that it is a reasonable proxy for transaction costs. The exclusion of the size variable from the regression in panel B does not significantly affect any of the other coefficients.

It should be noted that in the model we test, the functional relationship between volume, the two risk components, and transaction costs is highly nonlinear [see Michaely, Vila, and Wang (1995)]. Potentially, we could have estimated the model's parameters using a maximum likelihood technique. However, this would require a precise knowledge of the tax distribution and weights of each trading group, which we do not have. We chose the alternative procedure, in which we estimated the directional prediction of the model about the relationship between those variables. Even within this estimation procedure there are several alternative ways to calculate the systematic and idiosyncratic risk. The model actually suggests that the systematic risk should be estimated as $\beta_i^2 \sigma_M^2$ and the idiosyncratic risk as σ_i^2 . To preserve consistency with the traditional pricing models, we scale each variable by the market variance and then take the square root of each variable. This scaling results in β_i as the measure of the systematic risk, and σ_i/σ_M as the measure of the idiosyncratic risk. This scaling makes the interpretation of our results more intuitive and easier to follow. Since most of our regressions are pooled cross-sectional time-series regressions, these variable specifications make the inference about the cross-sectional relationship valid because the variables are standardized to remove the effect of time-series patterns [see, for example, Chan, Hamao, and Lakonishok (1991)]. To ensure that our empirical results are not an artifact of this normalization of the risk factors, we repeated our experiment using $\beta_i^2 \sigma_M^2$ as the systematic risk proxy and σ_i^2 as the idiosyncratic risk proxy. Most of our conclusions are not affected by this alternative definition of the risk factors. The only exception is the relationship between the two types of risk. While the effect of the idiosyncratic risk is still larger (in absolute value), consistent with what we report in Table 3, the difference between the two coefficients is not significant.

Two more points deserve comment. First, it is possible that the connection between the risk factors and the abnormal volume around the ex-day may reflect the statistical properties of volume time series.¹⁵ To ensure that this is not the case, we selected a random day from the estimation period for each event and calculated its abnormal volume. The average random-day abnormal volume is practically zero. We also use these abnormal volumes in a regression similar to that reported in Table 3. The results indicate that no variable is significant. Second, to ensure that our results are not driven by potential trends in volume, we have added year-dummy variables to each of the regressions reported in the tables. This inclusion does not affect our results.

¹⁵ We would like to thank Jiang Wang for pointing this out to us.

3.2.3 The interaction between risk and transaction costs. Thus far, we have examined the direct effect of risk and transaction costs on trading volume. The effect of the idiosyncratic risk and beta on the ex-day volume of trade may vary, depending on the cost of transacting. First, as transaction costs increase, the negative effect of the market risk on trading volume increases (Implication 5). The effect of the idiosyncratic risk component on trading volume is predicted to be the opposite: as transaction costs increase, the effect of the idiosyncratic risk on trading volume decreases (Implication 6).

We test these predictions using a regression analysis. The dependent variable is the cumulative abnormal volume around the dividend distribution. The independent variables are the dividend yield, the idiosyncratic risk, the security's beta, and a size variable. In addition, we define Q_i to be zero if the ex-dividend day occurred before January 1976, and one if the ex-day occurred between January 1, 1976, and December 31, 1991. Both risk components are multiplied by these dummy variables. According to the model, the idiosyncratic risk component's coefficient should be lower and the beta coefficient higher prior to 1976, since the transaction cost levels were higher during this time period and there were fewer hedging instruments around (such as futures or options contracts). The results are presented in Table 4. In the first row, where all ex-dividend day observations are included, the dummy slope coefficient for the idiosyncratic risk is negative and significant, indicating that the idiosyncratic risk had a bigger (in absolute value) effect on trading volume after the transition from fixed to negotiated commission schedule. The beta coefficient has a much larger coefficient prior to 1976, consistent with the assertion that as transaction costs decreased and more hedging vehicles became available, the beta risk had a smaller effect on trading volume.

In the second row of Table 4, we present the results for the high-yield group (top one-third yield). Consistent with our prior analysis, the effect of both risk components is more negative on this yield group than for the entire sample. The change in transaction costs also has a bigger effect on both the beta and the idiosyncratic risk coefficients. The beta coefficient is less negative after the reduction in transaction costs, and the idiosyncratic risk coefficient is more negative.¹⁶ Finally, the results reported in the last row show that while the risk components negatively affect the trading volume for the bottom two-thirds

¹⁶ In this analysis, our proxy for transaction costs is defined over a long period of time. We wished to check that the regression results were robust to a change in the time period examined. We therefore repeated the analysis, limiting the sample to the 10 years around the change in transaction costs. We still find that the beta coefficient is less negative after the reduction in transaction costs, and the idiosyncratic risk coefficient is more negative. The differences are significant.

Table 4
The effect of the systematic and idiosyncratic risk components in the two different transaction costs regimes

$$CAV_i = \alpha_0 + \alpha_1 \left(\frac{D}{P} \right)_i + \alpha_2 \frac{\sigma_{e,i}}{\sigma_m} + \alpha_3 \frac{\sigma_{e,i}}{\sigma_m} Q_i + \alpha_4 \beta_i + \alpha_5 \beta_i Q_i + \alpha_6 \text{Size}_i$$

Dep. Var. (CAV)	Intercept	$\left(\frac{D}{P} \right)_i$	$\frac{\sigma_{e,i}}{\sigma_m}$	$\left(\frac{\sigma_{e,i}}{\sigma_m} \right) Q_i$	β_i	$\beta_i \cdot Q_i$	Size _i	$\overline{R}^2$
(1) Entire sample	1.83 (15.1)	68.08 (8.49)	-0.43 (-16.75)	-0.06 (-1.98)	-0.58 (-10.66)	0.44 (6.10)	0.043 (6.14)	1.72
(2) High yield	4.225 (13.97)	51.70 (6.21)	-0.982 (-13.85)	-0.291 (-4.05)	-2.356 (-14.40)	2.27 (11.53)	0.173 (7.82)	3.48
(3) Medium- and low-yield groups combined	1.124 (12.19)	4.59 (0.53)	-0.171 (-7.80)	0.06 (1.67)	-0.24 (-4.27)	0.013 (0.17)	-0.02 (-4.08)	0.81

The systematic risk is hypothesized to have a greater effect on trading volume when transaction costs are high, and the idiosyncratic risk to have lower impact on trading volume when transaction costs are high. The dependent variable is the CAV in the 11 days around the ex-day for the entire ex-day sample (first row), for the high-yield group only (second row), and for the low- and medium-yield groups combined (third row). The independent variables are the stock's dividend yield, calculated as the dividend paid over the cum-day price; the idiosyncratic variance, scaled by the market variance; the systematic risk, estimated by beta; and the average market value of equity. The risk components are estimated using the OLS market model during the estimation period. Q_i is a dummy variable that takes the value of one if the ex-day occurred after December 31, 1975, and zero otherwise. Using this variable we create two slopes dummies, one for each risk component. Size (the average market value of equity in the estimation period) is used as a proxy for the cross-sectional variation in transaction costs. Standard errors are adjusted for heteroskedasticity using White's (1980) procedure. *T*-statistics are reported in parentheses.

of the sample (in terms of their yield), the change in transaction costs had no significant effect on these coefficients.

Overall the results of this section demonstrate the importance of transaction costs and risk on trading volume. When trading occurs because of differential valuations of cash flows, an increase in risk (either systematic or nonsystematic) reduces trading volume. The effect of the nonsystematic risk component is larger than the effect of the systematic risk. Also, the data confirm the assertion that trading volume and transaction costs are negatively correlated. The model's predictions about the interaction between transaction costs and risk, and the effects on trading volume, is supported by the data: the effect of the systematic risk on volume is more pronounced at times when trading costs are high, and the idiosyncratic risk has a larger effect on abnormal volume when trading costs are low. The evidence is also consistent with the assertion that most investors who trade around the ex-day do so in stocks with large dividend yields. These stocks therefore will be affected the most by changes in transaction costs or by the availability of hedging instruments through the direct effect of transaction costs and the indirect effect of idiosyncratic and systematic risk.

3.3 The role of derivative assets

The evidence presented in the last section shows that risk and transaction costs significantly affect investors' trading decisions when their private valuations differ from the market's. It is therefore likely that the introduction of instruments that enable investors to reduce the ex-day trading risk will result in a higher trading volume. More specifically, derivative securities such as options can be used to reduce the risk exposure of the underlying transaction. Alternatively, they can be used to reduce the cost of a hedging strategy that is already in place. In both cases, the predicted effect is clear: we expect more trading, since both risk exposure and the effective costs of the entire transaction are lower.

One way to investigate the effect of the availability of hedging instruments on trading volume is to examine the effect of the introduction of a stock index futures contract, such as the Major Market Index (MMI) in July 1984. However, such a test may be problematic, since several other events may have occurred around the same time period (for example, the 1984 TRA, which increased the required holding period for corporations from 16 to 46 days).

This type of problem is much less severe around the introduction of stock options. First, stock options are introduced gradually and do not concentrate in a particular time period. Second, since a stock option is most likely to be used as a hedge against trades in the underlying

stock, other stocks in the same time period are less likely to be affected and can therefore be used as a control sample. To this end, we use our sample of stocks with a traded option. (The sample selection is described in Section 3.)

Table 5 presents summary statistics for this sample. First, we calculated the average dividend yield for the pre- and postlisting periods. For each firm in the pre- or postlisting sample, we calculated the dividend yield as the average yield over all the ex-dividend days in the 5-year period. The sample average yield was then calculated as the average firm's dividend yield. (This procedure was followed so that firms with a larger number of ex-day events would not receive a greater weight in calculating the sample average.) The same procedure was followed for the calculation of both the average dollar amount of dividend paid and the average price. The sample's average standard deviation of returns was calculated using daily returns in the year before (after) the option listings. The average amount of dividend paid was \$0.298 and \$0.312 before and after the option listing, and the average dividend yield changed from an average of 0.834 percent to an average of 0.9 percent. Both differences are statistically insignificant. The average postlisting price is \$36.70, which is \$3.72 lower than the average prelisting price. The standard deviation of daily returns is somewhat lower after the listing: 2.153 compared with 2.257 before, but the difference is insignificant. Lastly, panel B presents the distribution of the inception of options in our sample by year.

We compare the trading volume activity before and after the option listing day in the following manner. We calculate the cumulative abnormal volume for each event using the procedure described in Section 3.1. Then, in order to give each stock in the sample the same weight, regardless of the number of ex-dividend days it had, we compute the average CAV for each stock in our sample in the period before and the period after the option listing. The mean cumulative abnormal volume, reported in Table 6, is the cross-sectional mean of CAV_i . The t -statistic is calculated using the cross-sectional variation of the cumulative abnormal volume. In the first column of Table 6 we report the CAV for the entire sample of 448 firms; in the second, we report the results for only those stocks that had a dividend greater than \$.125. The third column contains the CAV of the top one-third of stocks in terms of their yield. The results indicate that the volume of trade significantly increases after the option listing: the cumulative abnormal volume is 32.8 percent, compared with 118.6 percent for the pre- and postlisting periods, respectively. This difference is significant at the 1 percent level ($t = 5.88$). The same results emerge from the sample of the higher-yield stocks, or only stocks with dividend yields greater than \$.125: the level of abnormal volume is significantly higher

Table 5
Descriptive statistics for options-listed NYSE and AMEX stocks from April 1973 through December 1987

Panel A: Stocks' Dividends and Prices Before and After Options Listing

	Dividend yield (%)	Dollar dividend	Average price/share	Daily standard deviation (%)
Prelisting	0.834 (0.48)	0.298 (0.24)	40.42 (27.6)	2.257 (0.68)
Postlisting	0.900 (0.49)	0.312 (0.24)	36.70 (21.2)	2.153 (0.67)
Difference ¹	-0.066 (0.41)	-0.140 (0.17)	3.73 (19.4)	0.103 (0.69)

Panel B: Option listing by year

Year	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Total
Number of options listed ²	29	8	89	46	13	1	0	59	8	56	17	15	37	28	42	448

A firm is included in the sample if it has at least four ex-dates in the 3 years prior to the option listing, and at least four ex-dates in the 3 years after the option was listed. The dividend yield and dollar dividend is calculated as the mean over the pre- and postlisting periods (5 years). Average prices are calculated using the cum-day prices, and the daily standard deviation is calculated using daily prices for the years before and after the option listing. Average values are reported in the body of the table, and standard deviations are in parentheses. 448 companies are included in the sample.

¹Standard deviations are calculated using a pairwise comparison.

²Only stocks that are included in our sample.

Table 6
Trading volume before and after option listing

	Cumulative abnormal volume (%)		
	Entire sample (448 obs.)	Only stocks with dividend > \$.125 (347 obs.)	Top 1/3 of sample (by yield) (149 obs.)
Prelisting	32.8 (4.06)	42.64 (7.33)	83.61 (3.95)
Postlisting	118.6 (7.27)	146.3 (12.33)	297.28 (4.35)
Prelisting minus Postlisting ¹	-85.82 (5.88)	-103.6 (9.94)	-213.67 (5.55)

The table reports the CAV in the 11 days centered around the ex-dividend day for a sample of stocks with traded options, in the 5 years before and the 5 years after the options start to trade. A firm is included in the sample if it has at least four ex-dates in the 3 years prior to the option listing, and at least four ex-dates in the 3 years after the option is listed. CAV_{*i*} is first calculated for each firm (either before or after the option listing), and then the average CAV for each respective sample is calculated. The sample contains 448 firms. In the second column we exclude all stocks that pay dividends less than \$.125 and in the last column only the top third of the stocks (in terms of yield) are included. *T*-statistics are in parentheses.

¹ *T*-statistics are based on pairwise comparison.

after the option listing than before. Consistent with our prior findings, the absolute level of abnormal trading volume is higher both before and after the option listing for the high-yield groups, compared with the entire sample.¹⁷

It is possible however, that part of the increase in the abnormal volume can be attributed to other factors (either general trends in abnormal volume or factors specific to the firms in this subsample). To control for this potential confounding effect, we use an alternative procedure. For each firm with a listed option we find a matching firm without a listed option, and compare their abnormal volume of trade around the ex-day. In order to find the matched sample we screen the CRSP tapes for stocks without options traded in the same time period (in the first 3 years after the option listings). We then choose a subsample of stocks with a dividend yield that is in the 20 percent range of the yield of the stock with option. From this group we select all stocks with market value of equity in the 50 percent range of the stock with option, and then we select the stock that is closest in price.

¹⁷ We want to ensure that the differences in abnormal volume around the ex-day are indeed because of the better hedging possibilities investors face after the option listing, and not because of lower transaction costs on the underlying stock. Therefore, we calculate the average bid-ask spread (open, midday, and close) in the 3 months before the option listing and for the 3 months after the option listing (days -65 to -5, and +6 to +65, respectively, where day 0 is the option listing day). Since our bid-ask spread data start at 1988 and the option data end at 1987, we collect a sample of 30 stocks whose underlying option started to trade between April and September 1990. The mean bid-ask spread is 1.07 percent, before the listing and 1.20 percent after. The *t*-statistic of the difference is 1.69. It seems, therefore, that it is not a reduction in spread that drives our result.

Table 7
Descriptive statistics for option-listed stocks and their matched sample

	Dividend yield (%)	Market value (in billions of \$)	Price	Standard deviation
Stocks with options	0.83 (0.508)	1.112 (0.923)	34.21 (16.54)	2.22 (0.68)
Stocks without options	0.823 (0.537)	0.8495 (1.17)	31.64 (21.08)	1.97 (1.22)
Mean difference	0.0177 (0.11)	0.2623 (0.705)	2.57 (17.24)	0.249 (0.75)

The table compares the average price, size, dividend yield, and standard deviation of return between a group of stocks with options traded and a matched group of stocks without traded options. For each stock in the former group, we select a matching stock using the following criteria. We first screen the CRSP tapes for stocks without options traded in the time period of the option listing, with a dividend yield in the range of ± 20 percent of the yield of the stock with option. From this group we select all stocks with a market value of equity in the range of ± 50 percent of the equity value of the stock with option, and then we choose the stock that is closest in price. Standard deviations are in parentheses.

This procedure is repeated for every stock with an underlying option. Using this criterion, we are able to find 368 matched pairs of stocks with and without options.

The sample characteristics are described in Table 7. The dividend yield, market value of equity, and the daily standard deviation in returns are insignificantly different from each other between the two samples. The average price of the stocks with options is about \$2.50 higher than the stocks without options.

When comparing the cumulative abnormal return of the two samples (Table 8, panel A, column 1), we find that the difference in the volume of trade is significantly higher for the stocks with options than for the stocks without options, 130.4 and 99.4 percent, respectively. It is worth noting, however, that when comparing the mean CAV in the periods before and after the option listing, we find that the mean CAV is about four times higher after the listing (32.8 compared with 118.6 percent, as reported in Table 6). The differences are lower (though still significant) when the comparison is done on a cross-sectional basis instead of on a time-series basis. We find only a 30 percent difference between stocks with and without options when the time variable remains constant. This seems to imply that at least part of the increase in the trading volume after the option listing is related to some other trends in the market and not directly related to the option listing *per se*. As reported in the last two columns of panel A, we find a significant difference in trading volume around the ex-dividend day even after we eliminate stocks with dividends smaller than \$.125 (second column), or include only the high-yield securities in the sample (third column).

Table 8
Ex-day trading volume for stocks with and without traded options

Panel A: Option listing and trading volume

	CAV (%) entire sample ($N = 368$)	CAV (%) only stocks with yield greater than \$.125 cents ($N = 288$)	High-yield stocks only
Stocks with options	130.4 (10.83)	156.4 (4.29)	322.6
Stocks without options	99.4 (5.84)	117.6 (3.45)	208.7 (2.80)
Mean-difference ¹ (without-with)	-30.95 (2.25)	-38.78 (2.44)	-113.9 (2.29)

Panel B: Option listing and the effect of risk on trading volume

$$\text{AveCAV}_i = -1.91 + 365.5 \text{ AveYLD}_i - 0.732 \frac{\sigma_{ei}}{\sigma_m} \text{OPT}_i - 1.18 \frac{\sigma_{ei}}{\sigma_m} (1 - \text{OPT}_i) - 0.34 \beta_i \text{OPT}_i - 1.56 \beta_i (1 - \text{OPT}_i) + 0.77 \text{size}_i$$

$(-1.88) \quad (3.35) \quad (-1.835) \quad (-2.765) \quad (0.791) \quad (-1.83) \quad (2.045)$
 $(\bar{R}^2 = 17.05)$
 $[\text{NOB} = 736]$

Panel A reports the CAV in the 11 days centered around the ex-dividend day for a sample of stocks with traded options and a matched sample of stocks without options. For each stock with option we match a dividend-paying stock without option that traded in the time period of the option listing. Matching is based on dividend yield, market capitalization, and size. CAV_{*i*} is first calculated for each firm (either with or without a listed option), and then the average CAV for each sample is calculated. *T*-statistics are reported in parentheses. Using pairs of stocks with and without options, we examine in panel B whether the risk components (β and σ_{ei}/σ_m) have a different effect on ex-day volume, as a function of whether the stock has an underlying traded option. The dependent variable is the average CAV around the ex-day for each stock, using data from the first year after the option started to trade. (Since most stocks pay quarterly dividends, we use four ex-days' CAVs per stock for most stocks in our sample.) The independent variables are the stock's average dividend yield, YLD (the average yield in all ex-days in the 1-year period, beginning with the option listing day), the idiosyncratic risk, scaled by the market risk, σ_{ei}/σ_m , and the systematic risk, estimated by β . The risk components are estimated using data from the first year after the option was listed, excluding day -5 to $+5$ around each ex-day. OPT_{*i*} is a dummy variable that takes the value of one as the stock that has an underlying option, and zero otherwise. Standard errors are adjusted for heteroskedasticity using White's (1980) procedure. *T*-statistics are reported in parentheses.

¹ *T*-statistics are based on pairwise comparison.

If risk exposure affects the incentive to trade, as we argue, we should expect that the introduction of options not only increases volume, but also directly reduces the investors' sensitivity to the risk involved in the transaction. That is, the volume of trade around the ex-day should be less sensitive to risk if the stock has an underlying option. *A priori*, it can be argued that the existence of an underlying option would be most valuable for hedging idiosyncratic risk.

Using pairs of stocks with and without options, we examine whether the risk components (β_i and $\sigma_{\varepsilon i}/\sigma_M$) have a different effect on ex-day volume, as a function of whether the stock has an underlying traded option. The dependent variable is the average CAV around the ex-day for each stock, using data from the first year after the option started to trade. (Since most stocks pay quarterly dividends, we use four ex-day CAVs per stock for most stocks in our sample.) The independent variables are the stock's average dividend yield YLD (the average yield in all ex-days in the 1-year period, beginning with the option listing day); the idiosyncratic risk, scaled by the market risk, $\sigma_{\varepsilon i}/\sigma_M$; and the systematic risk, estimated by β_i . The risk components are estimated using data from the first year after the option was listed, excluding day -5 to $+5$ around each ex-day. The same variables are calculated for each of the stocks without options (the matched sample). OPT_i is a dummy variable that takes the value of one in the stock that has an underlying option, and zero otherwise. The results of this regression are reported in panel B of Table 8.

Idiosyncratic risk appears to inhibit ex-day trading even for stocks with options. The idiosyncratic risk coefficient is -0.732 for stocks with options and -1.18 for stocks without options (both are significantly different from zero). The coefficient is about 50 percent higher for the stocks without options; the t -statistic of the difference is 1.68. These results are in the direction we expect (less sensitivity to idiosyncratic risk for stocks with options). The negative coefficient on the stocks with options can be explained by the restrictions imposed by the IRS on the use of options for dividend capture, and by the transaction costs involved in this type of hedging. First, to receive the dividend exclusion, corporations cannot fully hedge their positions by totally offsetting their stock position with options [IRC 246(c)]. Second, even without this restriction, the transaction costs involved in the use of options as hedging vehicles result in trades that are not fully hedged, as the model predicts. The beta coefficient is -0.43 for stocks with options and -1.56 for stocks without options. Only the latter is significantly different from zero. The t -statistic of the difference is 1.34. As expected, both yield and size coefficients are positive and significant.

3.5 Portfolio effects

When investors incur transaction costs, not all of the systematic risk is hedged. By definition, this type of risk is correlated across stocks. Therefore, the trading volume on each individual stock will be a decreasing function of the number of stocks going ex (Implication 7). We test this implication by examining the effect of the number of stocks that go ex on a given day on the trading volume in each stock.¹⁸

The effect of the number of stocks that have the same ex-dividend day is examined in Table 9. We use regression analysis where the dependent variable is the cumulative abnormal volume. The independent variables are the dividend yields, the two risk variables, the transaction costs proxy (the size variable), and the number of stocks that go ex on the same day (ND). In the first row, we report the results for the entire sample. In the second and third rows, the results are reported for the high-yield group, and for the low- and medium-yield groups combined. First, consistent with Implication 7, the ND coefficient is negative and significant for the entire sample and for each subsample. It seems, however, that the number of stocks that go ex has a much greater impact on the high-yield group than on the rest of the sample. The ND coefficient is about 10 times larger for that group of stocks.

It can be argued that the negative ND coefficient reflects wealth constraints, not risk considerations. Obviously, if traders have only a fixed amount of capital, they will trade less in each stock if there are many stocks going ex. A possible way to separate these two explanations is to compare the ND coefficient in different transaction cost regimes. If the wealth constraint is the driving force behind the negative coefficient, then this coefficient will not be affected by a change in transaction costs. If the driving force is the joint effect of risk and transaction costs, then the coefficient should be larger in times of higher transaction costs, since less of the systematic risk is hedged. When we repeated the experiment in the two transaction costs regimes (before and after 1975) we found that the ND coefficient was significantly higher (in absolute value) before 1975 than after, consistent with Implication 7.

¹⁸ The mean (median) number of stocks that go ex on the same day is 20.63 (13), with a standard deviation of 20.56. The number of ex-dividend days is not uniformly distributed across days. For the entire ex-day sample, the maximum ex-dividend days in one day is 153 and the minimum is zero. We do not find evidence of yield-related clustering: the mean number of stocks going ex on a given day is 6.97 for all three yield groups. It is notable that the distribution of ex-dividend days across the days of the week is not even: there are twice the number of ex-days on Monday than on any other day of the week. We have also calculated summary statistics regarding the number of stocks that have an ex-dividend day in the same month. An average of 431.8 stocks have an ex-dividend day in a given month, with a maximum and a minimum of 805 and 16, respectively.

Table 9
The portfolio effect on ex-day trading

Dep. Var. (CAV)	Intercept	$\left(\frac{D}{P}\right)_i$	$\frac{\sigma_{ei}}{\sigma_m}$	β_i	Size _i	ND	$\overline{R}^2$
All ex-day	2.42 (18.07)	63.81 (8.47)	-0.477 (-18.22)	-0.371 (-8.55)	0.05 (6.73)	-0.013 (-13.14)	1.87
High yield	5.49 (15.72)	51.14 (6.137)	-1.17 (-14.124)	-0.88 (-7.58)	0.19 (8.78)	-0.028 (-13.25)	3.59
Medium and low yield	1.33 (13.73)	4.035 (0.47)	-0.164 (-8.48)	-0.24 (-5.74)	-0.02 (-3.07)	-0.003 (-3.78)	0.84

We examine the effect of the number of stocks that go ex in the same day (ND) on the trading volume activity of each stock. The dependent variable is the CAV in the 11 days around the ex-day for the entire ex-day sample (first row), for the high-yield group only (second row), and for the low- and medium-yield groups combined (third row). The independent variables are the number of stocks that go ex on that day (ND), the stock's dividend yield, calculated as the dividend paid over the cum-day price, the idiosyncratic variance, scaled by the market variance in the same time period, and the systematic risk, estimated by β . The latter two variables are estimated using the OLS market model during the estimation period. We use size (average market value of equity in the estimation period) as the transaction costs proxy. Standard errors are adjusted for heteroskedasticity using White's (1980) procedure. *T*-statistics are in parentheses.

3.6 Tax heterogeneity and trading volume

The higher the dispersion in investors' private valuation (e.g., tax rates), the stronger the incentives to trade, and consequently, the larger the volume of trade (Implication 1). Given the changes in the U.S. tax code and the changes in the relative importance of the various trading groups in the economy (which in turn determine the extent to which they affect ex-day volume), it is clear that the tax heterogeneity variable varies through time. In principle, if clientele groups could be precisely identified, one could construct a firm-specific tax heterogeneity variable. However, to the best of our knowledge, there is no reliable data on the cross-sectional variation in tax rates (and in absolute risk aversion) across holders of different stocks.

It is feasible, however, to estimate the time-series variations in tax heterogeneity. Using the *IRS Individuals' Statistics of Income and Corporations Statistics of Income*, and the *Federal Reserve Flow of Funds* publications for the years 1963 through 1985, we calculate the yearly mean and dispersion of the relative tax rate on dividends and capital gains across investors. Consistent with the functional form implied by the model, we measure dispersion as the average absolute deviation from the mean. The IRS publications provide information regarding the amount of dividend income received by individuals in each tax bracket as well as the amount of dividends received by corporations. The Federal Reserve publications contain information about the amount of dividends received by pension funds and insurance companies (institutional investors). From these data and the marginal tax bracket of each group, we are able to construct the yearly mean and

dispersion of the relative tax preference variable. The weights on each group's relative preference are set to the relative amount of dividends received by this group of investors. In the Appendix we present the yearly mean and dispersion of the relative tax rate on dividends and capital gains across investors.¹⁹

Another factor that may affect the level of abnormal trading volume through the tax heterogeneity is the incentive of the various groups to trade. In particular, corporate investors' incentives to trade, and their effects on the ex-day trading, are measured using three additional variables: the level of the market's weighted average valuation of dividends relative to capital gains, the return on the overall market in the current year, and the return on the market in the prior year. The first variable captures the increased weight of the corporate traders in the marketplace as it manifests itself through the mean of the distribution. The second and third variables capture the corporate traders' incentives to trade through a proxy of their capital gains.²⁰ Since the capital losses from dividend capture activity can be deducted only against capital gains, prior and current year changes in the level of the market are used as proxies for corporate capital gains. As the level of capital gains increases, the incentives to trade around the ex-day increase as well. In other words, the higher the level of corporate profits from capital gains, the higher the incentives to trade around the ex-day.

Given the nature of our test, we construct a monthly abnormal volume variable. The mean cumulative abnormal volume for each month is calculated as the average of the cumulative abnormal volume for all securities with an ex-dividend day in that month, weighted by the market capitalization of the firm's equity. We then estimate the effect of differential valuation on the monthly abnormal volume:

$$CAV_t = a_0 + a_1 \left(\frac{D}{P} \right)_t + a_2 RM_t + a_3 RM_{t-1} + a_4 \bar{\alpha}_t + a_5 DISP_t + a_6 \sigma_{mt}^2 + a_7 Log_t + \zeta_t \quad (8)$$

¹⁹ We note that our construction of the tax heterogeneity variables are only proxies. First, the weights are proportional to the dividend received, not to the risk tolerance. This can be justified by noting that the share of dividends received is a reasonable proxy for risk-bearing capacity. Second, our measure of the tax heterogeneity variable is available on a yearly basis only, which implies that we actually measure discrete, year-end changes in tax heterogeneity. Since most tax changes occur at year-end (though changes in the weights of the various trading groups do not), this empirical approximation may be appropriate. We note that Poterba (1987) arrives at a very similar estimate of the mean of the tax heterogeneity distribution using a slightly different data source.

²⁰ Eades, Hess, and Kim (1994) explain a portion of the time-series variation in ex-day returns by the portfolio dividend yield and the T-bill rate. The T-bill rate captures changes in business cycles. It is therefore likely to capture similar effects as our proxies for the corporate traders incentives to trade around the ex-day.

where $\bar{\alpha}_t$ is the mean and $DISP_t$ is the dispersion of the tax preferences distribution.

The results of estimating Equation (8) using monthly data for the years 1963 to 1985 are reported in Table 10. We note that a potential complication here is the activities of the Japanese insurance companies in the mid- and late 1980s. Their dividend-related trades are regulatory rather than tax motivated. While this type of incentive can be easily incorporated into the model, it is not captured in the tax heterogeneity variable. As shown in Koski (1992), these trades had a substantial effect on the volume of trade, especially in 1988. We therefore limit our time series to the period 1963 to 1985.

In addition to the explanatory variables described above, estimating Equation (8) includes a monthly dividend yield variable, calculated as the average dividend yield of all stocks with an ex-dividend day in that month, weighted by their market capitalization; the monthly market variance σ_{mt}^2 , calculated as the daily return variance of the equally weighted index in the 60 days prior to month t ; and a log time variable (in years) that captures other potential trends in trading volume through the years, $\log(t)$. Finally, it is possible, and quite likely, that because of transaction costs, individual investors will not engage in the ex-day trading to a large extent. In that case, the variability in the tax rates (and weights) of this investor group may not affect the ex-dividend day volume, and in fact may not even be the appropriate measure of the cross-sectional dispersion of the tax preferences that affect these type of trades. We therefore calculate an alternative measure of dispersion ($DISP_t^*$) that includes the weights and relative tax rates of corporations and institutions alone. We account for the serial correlation present in the data using a maximum likelihood procedure, as in Beach and MacKinnon (1978).

In the first and second rows of Table 10, the regressions are estimated for all ex-dividend day events in the sample period. In the second regression, however, we use the cross-sectional dispersion that accounts for the variation in the relative tax rates and weights of only corporate and institutional investors, $DISP_t^*$. The results of using either variable are quite similar: the yield coefficient is positive and significant, indicating that the time-series variation in ex-dividend day abnormal trading volume is positively related to the amount of dividend paid in a particular month. Also, as the risk level in the market increases (measured by the market's variance), the trading volume decreases. It appears that the effect of dividend yield and risk on the time-series behavior of abnormal volume takes the same direction as the cross-sectional behavior of ex-day abnormal volume. The measures of the corporate traders' incentive to engage in the ex-day trading are all in the right direction, but significant only for the second

Table 10
The effect of tax heterogeneity on trading volume

	Dep variable monthly (CAV) _t	Constant	$\left(\frac{p}{r}\right)_t$	RM_t	RM_{t-1}	$\bar{\alpha}_t$	$DISP_t$	$DISP_t^*$	σ_{mt}^2	$\log(t)$	R^2	DW ^a
(1)	All securities	-1.49 (-0.47)	111.41 (2.10)	0.52 (0.93)	0.58 (1.03)	0.45 (1.13)	0.31 (0.29)		-0.47 (-2.24)	-0.36 (-1.29)	11.5	2.05
(2)		-17.13 (-3.41)	141.22 (2.41)	0.93 (1.65)	0.57 (1.00)	1.66 (3.14)		4.70 (2.69)	-0.52 (-2.43)	0.007 (0.03)	12.92	2.03
(3)	High-yield group	-32.48 (-4.34)	241.33 (2.47)	2.21 (2.60)	1.27 (1.74)	4.17 (4.17)		7.03 (2.64)	-0.85 (-2.64)	-0.31 (-0.80)	19.1	2.01
(4)	Low- and medium-yield group	1.71 (0.50)	102.45 (1.13)	0.15 (0.28)	-0.001 (-0.002)	-0.19 (-0.42)	-0.48 (-0.86)		-0.34 (-1.59)	0.06 (1.00)	1.17	2.09

We construct a series of monthly mean abnormal volume using the CAV of all NYSE/AMEX stocks with an ex-dividend day in that month. We test the effect of tax heterogeneity and risk on abnormal volume using regression analysis. The dependent variable is a monthly time-series CAV calculated as the average of the CAV (in the 11 days around the ex-day) for all securities with an ex-day on that month, weighted by the market capitalization of the firm's equity. The independent variables are the weighted monthly dividend yield, D/P , the market return in prior year RM_{t-1} , and current year, RM_t ; the weighted average of preference of dividends relative to capital gains, α , a tax heterogeneity variable, $DISP_t$, the variance of market return in the prior three months, σ_{mt}^2 , and an indicator variable for time, $\log(t)$. The market return on the NYSE/AMEX value-weighted portfolio in the current and prior years are used as a proxy for corporate capital gains, which affect their incentive to engage in dividend capture. $\bar{\alpha}$ is calculated using data on the marginal rate of substitutions between dividends and capital gains for each trading group, as well as actual statistics (from the SOI bulletin) on the relative weights of each group. The tax heterogeneity variable measures the within-year variability in those preferences. We calculate the dispersion, $DISP$, as the weighted absolute deviation from the mean for each period (year) in the sample. $DISP_t$ includes all trading groups and $DISP_t^*$ includes only corporate and institutional traders. Lastly, the market variance tries to capture the perceived risk involved in those transactions. We account for the serial correlation present in the data using a maximum-likelihood procedure as in Beach and Mackinnon (1978). The regression is estimated in the period 1963 to 1985. In the first row of the table, the results are presented for the entire sample of securities; in the second row, we analyze the top one-third of stocks, in term of their yield, alone; and in the last row the analysis is applied to the bottom two-thirds of securities, sorted by yield. *T*-statistics are in parentheses.

^a Durbin-Watson statistics for transformed residuals.

regression. That is, as $\bar{\alpha}$ increases, which indicates greater presence of corporate traders, the abnormal volume increases as well, and is significant when the heterogeneity variable accounts for the activity of institutional and corporate traders. Likewise, the market's return coefficient is positive and significant at the 10 percent level, indicating that a higher level of capital gains increases the incentive to trade, and consequently increases volume. Perhaps most importantly, as the degree of tax heterogeneity between institutional and corporate traders increases, the volume of trade increases in a significant way.

In the third row of Table 10, we analyze the effect of these variables on a subsample where the corporate and institutional trading is the most pronounced, namely on the high-yield stocks. Those securities are more likely to attract ex-dividend day trading because of their high dividend yield, which makes such trades more profitable (Implication 2). Indeed, the current level of the market, as well as $\bar{\alpha}$ and the tax heterogeneity variable, are positive and highly significant, and the market risk proxy is negative and significant. Comparing the level of the coefficients between Equations (2) and (3) indicates that all these variables play a more important role in determining the volume of trade for the high-yield stocks than for the entire sample. A consistent picture emerges from the last regression in Table 10 (fourth row). When only the bottom two-thirds of the sample (in terms of yield) are included, none of the variables are statistically significant. These results are not surprising if individual investors face higher transaction costs than do large institutional and corporate traders and are thus prevented from actively participating in the ex-dividend day trading.²¹

Overall the results indicate that heterogeneity has a significant effect on trading volume, especially in stocks where corporate and institutional traders are dominant. The results also show that when the incentives to engage in these trades (proxied by level of capital gains and dividend yield) are higher, the volume of trade is significantly higher. The amount of risk involved in these trades, on the other hand, reduces the trading volume.²²

²¹ It is still possible that delay and acceleration of trades by individual investors may occur [see Grundy (1985)]. Michaely and Vila (1995) document evidence around the 1986 TRA that is consistent with this assertion.

²² The positive relationship between heterogeneity and ex-day trading volume is also supported by the findings of Michaely and Murgia (1995). Using data from the Milan stock exchange, they find that there is no abnormal trading volume for stocks where all investors pay the same taxes. In contrast, for stocks with differential tax treatment across investors, significant abnormal volume is found.

4. Conclusions

In this article we consider the impact of investors' heterogeneity, risk, and transaction costs on trading volume. We focus our empirical analysis on trading volume around ex-dividend days. These events represent an almost ideal environment for our experiment, since the dominant motive for trade around these events is the differential valuation of cash flows (dividends relative to capital gains) across investors.

Consistent with the model's implications we find that (1) the amount of trading is positively related to the dividend yield. (2) Stocks with higher transaction costs experience lower abnormal trading volume. (3) Risk inhibits trading, but the systematic risk and the idiosyncratic risk have different effects on the trading volume. As transaction costs decrease, as they did in 1975, the effect of the beta risk is reduced (because investors can hedge it more cheaply) and the effect of the idiosyncratic risk is increased. (4) Consistent with the effect of risk on ex-day trading volume, we find that the introduction of an option on a stock results in a significant increase in trading volume. We also show that the volume of trade is less sensitive to the risk components if an option exists.

The time-series variations in the abnormal trading volume around the ex-dividend day are positively related to the degree of tax heterogeneity and the incentives of the various trading groups to engage in those trades. Specifically, we find that as the influence of the corporate traders and their incentive to trade increases, the volume of trade increases significantly, especially in the high-yield stocks.

Finally, an important policy implication may be drawn from this line of research. Using the volume of trade and the price movement on the ex-dividend day, it is possible to estimate the amount of tax revenue that is lost due to those trades. Our empirical results show that the amount of tax-related trading is substantial. There are three parties involved in those trades: the buyer, the seller, and the government. Both the buyer and the seller expect a gain, while the government (the third party) bears a loss of tax revenues. In addition to the cash transfer from the government to the traders, tax-related trading around the ex-day creates deadweight loss. This deadweight loss is due to the cost of trading the tax shields (commission, time spent, etc.) and the risk involved in the transactions (deviation from Pareto optimal risk sharing). From our discussion, it follows that an estimate of the tax revenue losses due to ex-day trading will shed some light on the distributional and efficiency impacts of tax arbitrage. As a result, such an estimate will undoubtedly interest policymakers. Indeed, even if the wealth transfer due to tax arbitrage is desirable, the fact that risk and transaction costs create a deadweight loss suggest that there should be a more efficient distribution mechanism.

Appendix: The Tax Heterogeneity Variable

We use the *IRS Statistics of Income* and the *Federal Reserve Flow of Funds* publications to calculate the weighted average valuation of dividends relative to capital gains and tax heterogeneity across investors for each year in the sample period. The *IRS Statistics of Income* provides us with information about the amount of dividends received by individuals and corporations in each tax bracket. The *Federal Reserve Flow of Funds* contains similar information for tax-exempt institutions. The relative weights for each group are calculated in proportion to the amount of dividends received. We then calculate the mean valuation and heterogeneity variables as follows:

$$\bar{\alpha}_t = \sum_i \omega_{it} \alpha_{it},$$

where ω_i is the relative weight of group i ($\sum_i \omega_i = 1$), and α_i is the relative valuation of dividends to capital gains of group i , [calculated as $(1 - \tau_d^i)/(1 - \tau_g^i)$. τ_d and τ_g are the tax rates on dividends and capital gains]. The heterogeneity variable is calculated as the weighted absolute deviation from the mean:

$$DISP = \sum_i \omega_i |\alpha_i - \bar{\alpha}|.$$

$DISP^*$ is calculated in the same fashion as above for only corporate and institutional investors.

We report the yearly value of these variables ($\bar{\alpha}_t$, $DISP_t$, and $DISP_t^*$) in Table A.1. Several trends are noticeable. First, the market's relative valuation of dividends to capital gains (estimated by $\bar{\alpha}$) has increased through the years. This is due in part to the decrease in the relative importance of individual investors in the marketplace in the last 35 years. For example, individual investors received a weight of about 70 percent in 1963, but only 55 percent in 1985.²³ Another reason may be that the marginal tax rates on individual investors have been reduced through the years.

The second variable ($DISP$) indicates that the tax heterogeneity in the 1980s is lower than in the 1960s and 1970s. The shift in weights from individual (the most extreme dividend-averse group) to institutional and corporate traders throughout the years, and the reduction in the marginal tax rates on individual investors, have attributed to this shift. An example is the 1981 TRA, the most significant tax change in

²³ This assertion is also supported by evidence from the ex-day behavior. Michaely (1991) finds that the average price drop (between the cum- and the ex-day) relative to the dividend paid was closer to one in the 1980s relative to the 1960s.

Table A.1

Cross-sectional estimate of means and dispersions of the relative preferences of dividends and capital gains across investors by year.

Year	$\bar{\alpha}_t$	DISP _t	DISP* _t
1963	0.815	0.4529	0.2883
1964	0.878	0.4328	0.2709
1965	0.872	0.4344	0.2664
1966	0.891	0.3937	0.3039
1967	0.878	0.3886	0.3080
1968	0.854	0.3581	0.3242
1969	0.875	0.3806	0.3280
1970	0.895	0.3888	0.3331
1971	0.919	0.3834	0.3431
1972	0.936	0.3917	0.3475
1973	0.987	0.4114	0.3444
1974	0.980	0.4382	0.3407
1975	0.936	0.3870	0.3610
1976	0.969	0.4071	0.3568
1977	0.980	0.4072	0.3575
1978	0.947	0.3870	0.3619
1979	0.970	0.4011	0.3613
1980	0.955	0.4103	0.3603
1981	0.911	0.3755	0.3609
1982	0.965	0.3152	0.3583
1983	0.984	0.3110	0.3578
1984	1.010	0.3240	0.3610
1985	0.958	0.2925	0.3515

We use data from the *IRS Statistics of Income* and the *Federal Reserve Flow of Funds* publications. This table presents the weighted average valuation of dividends relative to capital gains and tax heterogeneity across investors for each year in the sample period. The mean valuation is calculated as $\bar{\alpha}_t = \sum_i \omega_i \alpha_{it}$ where ω_i is the relative weight of group i (calculated in proportion to the amount of dividends received) and α_i is the relative valuation of dividends to capital gains of group i [calculated as $(1 - \tau_d^i)/(1 - \tau_g^i)$ where τ_d and τ_g are the tax rates on dividends and capital gains]. The heterogeneity variable is calculated as the weighted absolute deviation from the mean: $DISP = \sum_i \omega_i |\alpha_i - \bar{\alpha}|$. $DISP^*$ is calculated in the same fashion for only corporate and institutional investors.

our sample period. Relevant to our investigation is the fact that the highest marginal tax rate for individual investors was reduced from 70 to 50 percent, and the number of tax brackets were reduced from 16 to 10. These changes resulted in a reduction in the heterogeneity of about 20 percent (from 0.3755 to 0.3152).

It is interesting to note, however, that the dispersion in valuation among corporations and institutions ($DISP^*$) has increased through the years. The reason for this increase is the more equal weight in trading attributed to institutional and corporate investors. For example, the average weight of the tax-exempt institutions was 9.1 percent in the 1960s, and 24.5 percent in the 1980s. In the same time period, the corporate weights were 22.5 and 21.1 percent, respectively. The 1984 TRA represents the only significant (though indirect) change in the tax code regarding the relative valuation of dividends to capital gains for corporate investors. This reform increased the holding period of dividend-paying stocks from 16 to 46 days for those corporate traders

who wished to receive the partial tax exemption on dividends. Indeed, the corporate weight dropped from 22.68 to 17.68 percent between 1984 and 1985.

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